WEAPONS EFFECTS IN URBAN OPERATIONS IN SUPPORT OF COMBATANT COMMANDERS: REQUIREMENTS FOR TESTING, ANALYSIS, MODELING AND SIMULATION*

Rayment E. Moxley, James D. Cargile, and Jon Windham
US Army Engineer Research and Development Center, Vicksburg, MS 39180-6199

Randolph S. Coates and Dave Fordyce, and Bill Mermagen, Jr.
US Army Research Laboratory, APG, MD 21005

1.0 INTRODUCTION

Warfighters have studied how best to design and array their weapon systems in order to impose his will on his adversary and achieve his military goals to obtain a desired end state. The pursuit of the knowledge and the understanding of science required to achieve their objective continues today. In the past decade priorities have shifted from the open range to the confined spaces of the urban environment. The complexity of waging a war has increased exponentially among the three primary variables in understanding weapon effects, the weapons, the environment, and the combatant commander's objective. Historically we were concerned with the understanding of how to either defeat or protect assets contained in massive hardened structures that are subject to attack only by large air delivered munitions. Direct and indirect fire weapons in our arsenals were primarily developed for use against vehicles, equipment, supplies, and personnel.

Today our forces must engage an enemy hiding within a complex urban environment containing a myriad of potential conventional structural targets. Today our forces must employ a large array of direct and indirect fire munitions to weed out a toughened enemy that can be side-by-side with innocents, allies, and friendlies. Our combatant commanders must employ the right weapon against a unique target to accomplish a specific objective from across the spectrum of combatant commander's requirements, while following a strict set of rules of engagement. Today, we need to understand how to effectively apply this array of weapons against fixed conventional structures in a complex urban terrain to defeat the enemy without undue damage to the infrastructure and injury to innocents and noncombatants; we know that air-delivered weapons are too large to efficiently accomplish attack missions in conventional structures without inducing excessive damage, destruction, and casualties. The ability to effectively employ weapons in the urban terrain is hampered by the lack of verified weapons effects prediction tools and data defining the interaction of direct and indirect fire weapons against urban construction materials. Fortunately, we now possess

highly detailed modeling and simulation (M&S) tools to perform comparisons and analysis of potential scenarios and alternatives as we seek to understand the relationship between the weapons, the environment, and the combatant commander's objective. A sufficient database of high-fidelity experiments must be populated to allow an understanding of the interaction between weapons and structures in order to provide insight into the proper M&S tools and an understanding of how that interaction translates into meeting the combatant commander's requirements.

2.0 CURRENT M&S CAPABILITIES AND REQUIREMENTS

Out of the Cold War came many benefits; one of those was a myriad of weapon-structure-interaction experiments performed by the DOD Services and Agencies to understand the problems threatening national security. Over the past half-century, the need to understand how to ensure the survivability of structures against an attack from air-delivered munitions and the lethal counter problem of defeating hardened bunkers, command posts, and similar type structures with air-delivered munitions, led to a vast collective effort among the tri-services and numerous DOD Agencies. Leaders within the various services, organizations, and agencies had the foresight to see the benefits of understanding the weapon-structure interaction and developing M&S analysis. We possess the knowledge base and scientific understanding that was built upon a myriad of experiments, conducted under many various research programs, to understand the physics and details of the interacting forces due to the different weapons effects. These resulting effects on structures can be predicted with a variety of M&S tools. Some of these have been through rigorous procedures of verification, validation, and accreditation (VVA) by subject matter experts.

M&S codes that predict weapons effects fall into one of three main types, very fast running empirical codes, analytical engineering codes or long running first principles codes such as finite element analysis methods. The unpredictable nature of urban warfare compounded by the rapidly changing operational situation dictate that commanders must make decisions rapidly. The battle staff planning and decision process can be enhanced with the

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use of predictive M&S capabilities that can be run by battle staff officers without tremendous technical expertise. The more detailed long running finite element methods are not feasible for use at the operational level but are useful for strategic level analyses when time is not critical. Fast running empirical models, and some analytical engineering codes, are useful for rapid battle staff analysis. Empirical models are limited to the in application to the range of conditions for which the models were developed. Use of this type of code outside that range can lead to improper decisions being made. Analytical engineering codes have some advantage over both as they provide much faster analysis than first principle codes, provide valid answers based on solution of equations of motions and laws of physics, and are valid for a wide spectrum of application within a well defined parameter space.

3.0 AN APPROACH TO MEETING URBAN OPS WEAPON EFFECTS M&S NEEDS

A limited experimental database has been used to demonstrate that current M&S tools possess the capability to predict some of the various direct and indirect fire weapons effects against several typical urban material types (Moxley et.al, 2004). Initial assessments are positive but limited by the small quantity of detailed data. Additional high-fidelity experiments of direct and indirect fire weapons effects against various typical urban material types are required. Definition of a complete and thorough database of all weapons effects and structure types encompassing all possible interaction variables would require a huge undertaking. With proper input from experts, the extent of data required could be pared down to a more manageable size by focusing on the high priority weapons-structure interactions most likely to take place. Input from urban operations combat veterans could be used to guide the researchers and identify priorities of the research efforts.

It has been demonstrated that the current M&S tools capable of predicting lethality and survivability of hardened structures attacked by large air delivered bombs may also be extended to encompass the potentially more complicated problem faced by combatant commanders in urban operations. Before these M&S tools can go through the VVA process and be considered valid for use in support of urban operations, the envelope of available data must be expanded. Additional data documenting how different munitions interact with different urban material types must be developed and documented. As new munitions come through the research and development process or go through the acquisition management process, it is possible that these data may be developed for evaluating and exercising the various codes.

4.0 SUMMARY

The current M&S tools capable of predicting lethality and survivability of hardened structures attacked by large air delivered bombs also possess the capability to be extended to encompass the potentially more complicated problem faced by combatant commanders in urban operations involving the effects of direct and indirect fired surface-to-surface munitions against urban structures. These tools should be improved through focused research programs and through support of acquisition programs. The impact can be improved munitions for urban warfare as well as predictive M&S for mission planning by warfighters.

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